

REMARKS

On page 2 of the final Action, claim 3 was objected to. On pages 3-6 of the final Action, claim 1-14 were rejected under 35 U.S.C. 103(a) by Boulos et al., Aratani et al., Nagashima et al. '122, Sakaguchi et al., and Nagashima et al. '896.

In this respect, claim 1, 3, 5 and 6 have been amended, and claims 10, 11, 13 and 14 have been cancelled. Since the subject matter as recited in claim 13 or 14 indirectly depending from claim 1 has been added to claim 1, the amendment does not introduce new issue.

A glass composition of the invention comprises 65 wt.% to less than 74 wt.% SiO₂; 0-5 wt.% B₂O₃; 0.1-2.5 wt.% Al₂O₃; 0.4 to less than 2 wt.% MgO; 5-15 wt.% CaO; 0-10 wt.% SrO; 0-10 wt.% BaO; 0-5 wt.% Li₂O; 10-18 wt.% Na₂O; 0-5 wt.% K₂O; and 0-0.40 wt.% TiO₂. A total amount of Li₂O, Na₂O and K₂O is 10-20 wt.%.

In the invention, a product of a mean linear expansion coefficient in a range of 50-350°C and Young's modulus is 0.71-0.90 MPa/°C, and a mean linear expansion coefficient in a range of 50-350°C is 80X10⁻⁷-110X10⁻⁷/°C.

In the invention, in case the thickness of the glass is less than 3.1 mm, the glass can be strengthened without increasing or intensifying reinforcing process. In case the thickness of the glass is more than 3.1 mm, the glass can be strengthened to have the same surface compression stress with an energy less than that used conventionally, thereby reducing the cost for strengthening. Namely, the glass of the invention can be strengthened easily.

In the invention, a specific combination of SiO₂, MgO and the total amount of MgO, CaO, SrO and BaO is used. As a result, the glass composition can be strengthened easily. Although the property is improved, the glass of the invention can be formed in a float process.

In the present invention, also, the linear expansion coefficient and Young's modulus are improved.

A conventional soda-lime-silica glass has a linear expansion coefficient of $85-90 \times 10^{-7}/^{\circ}\text{C}$ and Young's Modulus of 71.6 GPa (7300 kg/mm^2). Thus, the product of the linear expansion coefficient and Young's modulus is 0.61 to 0.64 MPa/ $^{\circ}\text{C}$. This value is less than the value of 0.71-0.90 MPa/ $^{\circ}\text{C}$ as now recited in claim 1. This means that the glass of the invention in the specific ranges as recited in claim 1 can be strengthened easily as compared with the conventional soda-lime-silica glass.

Conventionally, a thin glass plate with a thickness less than 3.1 mm can not be strengthened by air-blast cooling. However, the glass of the invention can be strengthened. Accordingly, the glass composition of the invention can provide a strengthened glass with the thickness less than 3.1 mm, which is generally considered impossible.

Generally, it is known that as the linear expansion coefficient becomes greater, Young's modulus becomes smaller. Therefore, it is not easily attained to increase both linear expansion coefficient and Young's modulus. In the glass composition of the invention, both linear expansion coefficient and Young's modulus can be increased.

For the glass with the thickness more than 3.1 mm, the glass can have the same surface compression stress as that of the conventional glass with energy less than that used conventionally, thereby reducing the cost for strengthening.

Aratani et al. cited in the Action discloses a method of strengthening a glass article by ion exchanging treatment to replace alkali metal ions in the surface layers of the glass with alkali metal ions larger in ionic radius. In the present invention, the glass is not subjected to the ion exchanging treatment used in Aratani et al., but the glass is strengthened thermally. Thus, Aratani et al. is entirely different from the present invention.

In Boulos et al., a glass has 68-75 wt.% of SiO₂, 5-15 wt.% of CaO, and 0-10 wt.% of MgO. Also, by adding some amounts of

Fe_2O_3 ($\text{Fe}^{2+}/\text{Fe}^{3+}$), MnO_2 , TiO_2 , CeO_2 , V_2O_5 , and Cr_2O_3 to the conventional soda-lime-silica glass, a glass with green color having excellent ultraviolet absorbing ability can be obtained.

In Nagashima et al. '122, a glass has 65-80 wt.% of SiO_2 , 5-15 wt.% of CaO , and 0-10 wt.% of MgO , wherein $\text{MgO} + \text{CaO}$ is 5-15 wt.%. In this invention, the ratio of the amounts of Fe_2O_3 , TiO_2 and CeO_2 with respect to the amount of FeO is specified, so that a green glass composition with ultraviolet and infrared ray absorption ability is obtained.

In Sakaguchi et al., a glass has 65-80 wt.% of SiO_2 , 5-15 wt.% of CaO , and 0-10 wt.% of MgO , wherein $\text{MgO} + \text{CaO}$ is 5-15 wt.%. Also, specific amounts of Fe_2O_3 ($\text{FeO}/\text{T-Fe}_2\text{O}_3$), TiO_2 , CeO_2 , CoO and Se are used, so that colored glass with excellent ultraviolet and infrared ray absorption ability is obtained.

In Nagashima et al. '896, a glass has 65-80 wt.% of SiO_2 , 5-15 wt.% of CaO , and 0-10 wt.% of MgO , wherein $\text{MgO} + \text{CaO}$ is 5-15 wt.%. By defining a ratio of amounts of Fe_2O_3 , TiO_2 , CeO_2 and La_2O_3 with respect to FeO , a green glass composition with excellent ultraviolet and infrared ray absorption ability is obtained.

In Boulos, Nagashima '122, Nagashima '896 and Sakaguchi, color compositions are added to conventional soda-lime-silica glasses which can be manufactured with a regular float system, so that the glasses have specific properties. In the present invention, it was found that in the very limited range of the conventional soda-lime-silica glass, the glass can be strengthened easily and manufactured with a float system. The cited references do not disclose or suggest the present invention.

In the present invention, the linear expansion coefficient and Young's modulus are improved by the specific combination and amounts of SiO_2 , MgO and the total amount of MgO , CaO , SrO and BaO . As a result, the glass can be strengthened easily.

The cited references show the regular soda-lime silica glass, and do not disclose the specific combination and the advantages of the invention. The linear expansion coefficient and Young's

modulus are not considered at all in the cited references. Therefore, the features of the invention are not disclosed or suggested in the cited references.

As explained above, the cited references simply disclose the conventional soda-lime-silica glass. The invention is not disclosed or suggested in the cited references.

Reconsideration and allowance are earnestly solicited.

Respectfully Submitted,

KANESAKA AND TAKEUCHI

By Manabu Kanesaka
Manabu Kanesaka
Reg. No. 31,467
Agent for Applicants

1423 Powhatan Street
Alexandria, VA 22314
(703) 519-9785